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Effect of Cervical Mobilization and Transcutaneous Supraorbital Nerve Stimulation in Migraine Without Aura

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ABSTRACT

Migraine is one of the most common disabling headache disorders which is categorized into two broad types based on the number of headache days. It is called episodic or general migraine if the attacks occur less than 15 days per month, and it is categorized as chronic or transformed migraine if headache occur on 15 or more days per month. This study was conducted to find out the effect of strategy for pain using a modality and strategy using mobilization in reducing disability, frequency and pain in migraine without aura. Thirty-Two subjects were selected based on diagnostic criteria for migraine and divided into two groups. Group A received Cervical Mobilization and Myofascial Release with home exercise program and Group B received Transcutaneous Supraorbital Nerve Stimulation with home exercise program. Visual Analogue Scale, Questionnaire (HIT-6) were recorded as outcome on baseline and after 3 weeks. Results showed significant improvements in both the groups with, $p < 0.01$. Between group comparisons elicited non-significant differences with $p > 0.05$. Following the results, it can be concluded that cervical mobilization and Transcutaneous Supraorbital nerve stimulation can be added as a valuable adjunct to medical management in the treatment of migraine without aura.



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INTRODUCTION

Migraine is a common disabling headache disorder with the typical features including moderate to severe intensity headache which is recurrent either

on side or both the sides of the head, throbbing in nature lasting hours to days. The headache is usually accompanied by nausea, photophobia, and Phonophobia and the pain is worsened by routine physical exertion (Bigal *et al.*, 2008). Majority of the migraine headaches are chronic headaches attributed to vascular or muscle tension or a combination of both. Due to its significant incidence among chronic headaches, migraine has been extensively researched and studied. But Pathophysiology of the disorder is poorly understood (Kewman and Roberts, 1980).

Migraine occurs predominantly between the ages of 18-65 year, with peak prevalence at approximately 40 years of age (Kewman and Roberts, 1980; Marcus *et al.*, 1998). Studies have estimated that 12.9% to 17.6% of women and 3.4% to 6.1% of men suffer from migraine. The western studies show a preva-

lence of around 18% in women and 6% in men with majority of the patients having moderate to severe pain and up to 33% of them with a reduced ability to function during the headache attack and 25% needing bed rest during their attacks. The majority of migraineurs remain undiagnosed by physicians (Lipton *et al.*, 2007). Episodes of severe Head pain is the most characteristic feature of migraine which is usually unilateral, in migraine without aura, the headache is associated with photophobia, phonophobia or to movement. The patient also has nausea and vomiting. These symptoms may last for few hours up to 3 days. Combination of these presentations help in diagnosing migraine even if all them are not present in every case. An aura typically consists of homonymous visual disturbances, paresthesia's and numbness on either one half or both sides of the head, weakness on one side, aphasia, or unclassifiable speech difficulty⁵. Patients sometimes describe the aura as an opaque object or random zigzag lines around clouds. Tactile hallucinations have been recorded in few patients with aura. Migraine with and without aura now are used synonymously to classic and common migraines (Arulmozhi *et al.*, 2005; Pietrobon and Striessnig, 2003). Recent studies put the prevalence of migraine without aura to 64%, 18% to patients with migraine with aura and 13% to patients demonstrating both types (Lipton *et al.*, 2007).

The role of trigeminal and cervical nociceptors in the development of migraine without aura are still not well understood. It is hypothesized that a cortical spreading depression (CSD) like phenomena may occur in non-eloquent area of the cerebral cortex during migraine without aura (Weiller *et al.*, 1995; Burch and Wells, 2013). According to vascular theory, the temporal blood vessels in migraine patients are found to be dilated and increase in their pulse pressure may activate the stretch receptors which in turn increase the activity of neuropeptides, specifically, calcitonin gene related peptide (CGRP) in the perivascular spaces of the nerves eventually causing pain and other associated symptoms (Arulmozhi *et al.*, 2005).

According to neurological theory of migraine, abnormal firing of the neurons due to neurotransmitter imbalance leads to migraine. The gradual progression of migraine headache can be associated with external factors, such as stress and hunger. According to neurogenic theory, blood flow changes occurring in migraine may be due to abnormal electrical inputs from the brain stem and intricate anatomical relationship between the trigeminal nerve and the cerebral vasculature. Neurogenic Dural inflammation seen in migraine can be asso-

ciated with the release of inflammatory neuropeptides from the primary sensory nerve endings innervating the Dural blood vessels. The Dural membrane surrounding the brain can be attributed to be a source for the majority of intracranial pain afferents and Dural stimulation produced headache like pain in human (Burch and Wells, 2013; Pietrobon and Striessnig, 2003).

MATERIALS AND METHODS

In this study convenient sampling was used, in which 32 subjects were selected on the basis of Selection criteria and divided into two groups. Participants were informed about the study procedure and written consent was taken. The study was also approved by the Institutional Ethical committee. The experiment adhered to the principles of declaration of Helsinki.

Inclusion Criteria

The International Classification of Headache Disorders, 2nd Edition (ICHD-II) (IHS, 2013, 2004).

A. Minimum 5 headache attacks fulfilling criteria B-D below

B. Headache attack lasting between 4hours to 3 Days (Cady and Dodick, 2002)

C. Headache with at least two of the following characteristics

1. Unilateral location on head
2. Pulsating quality of pain
3. Moderate or severe intensity of pain

D. Pain aggravated by routine Physical activity or patient avoiding routine physical activity as it will trigger pain (Guyuron *et al.*, 2002).

E. At least 1 of the following symptoms during headache

Exclusion Criteria

A. Migraine with aura consisting of (Nicholson *et al.*, 2011)

1. Fully reversible visual symptoms, including positive feature (flickering light, spots, lines)
2. Fully reversible sensory symptoms, including positive feature (numbness)
3. No Motor weakness

B. Rheumatoid arthritis

C. Malignancy

D. Pregnancy

E. Head due to any other cause

Dependent Variable

1. HIT-6 questionnaire
2. VAS

Independent Variable

1. Transcutaneous Supraorbital nerve stimulation
2. Upper cervical mobilization
3. Migraine without aura
4. Pain

Transcutaneous electrical nerve stimulation (pocket TENS), Couch, Chair with back rest, Cotton swabs, Towel.

Procedure

Out of 56 migraines without aura patients, 32 subjects participated in this study and randomly divided into two groups. Patients were explained about the nature of study and a complete assessment was taken before treatment. Sixteen subjects were allocated to the two groups (n=16), Group A received Cervical spine Mobilization + Myofascial Release + Breathing Exercises and Group B received Transcutaneous Supraorbital nerve stimulation + Breathing Exercises. Total treatment duration was 20 minutes.

Group A (mobilization - mulligan)

Step 1

The subject was made to sit comfortably and given 1-2 minutes time for relaxation and all physical activities were stopped prior to treatment. The therapist stands beside the seated patient, Subject's head is cradled between Therapist's chest and the left forearm if stood on subject's left side. The Left index, middle and ring fingers wrap around the base of the occiput and the middle phalanx of the little finger lies over the spinous process of C₂. The lateral border of the right thenar eminence lies over the left little finger.

Step 2

The therapist applies a gentle pressure directing towards the eye ball and direction on the spinous process of C₂ and C₃ while the subject's skull remains still due to the control of therapist's left forearm. The glide is applied gently with force generated from the right forearm through the thenar eminence over the left little finger on the spine of

C₂ and C₃. With C₂ moving forward under C₁ till slack is taken up and then the first vertebra moves forward under the base of the skull. This is quietly taken forward until end range is felt and this position is maintained for 10 seconds. These procedures were repeated 6-8 times, 4 days for 3 weeks (total treatment session 12 days) ([Christian, 2017](#); [Mulligan, 2018](#)) (Figure 1).



Figure 1: Showing Technique for Mulligan Mobilization of Upper Cervical Spine

Maitland Mobilization

Step 3

The patient is positioned in prone with forehead resting comfortably on his pronated hands. The therapist is in stride standing at the head end of the patient. Therapist places the tip of her thumb pads reinforced with each other over the C₂ spinous process. Therapist's arms are positioned vertical with extension of elbow and neutral position of wrists. Oscillatory Glide is delivered vertically down in posterior to anterior direction against spinous process. Initial slack is removed and grade 2 glide is delivered with the oscillations at 2-3 per second for 1-2 minutes ([Hengeveld and Banks, 2013](#); [Schoensee et al., 1995](#)) (Figure 2).



Figure 2: Showing Maitland's Mobilization of Upper Cervical Spine

Cranial Base Release

Step 4

The subject was made to lie supine comfortably and should be in loose clothes. They were given 1–2-minute time for relaxation and all physical activities was stopped prior to test. Stroking the posterior cervical musculature with both hands at the same time, ending with the heel of your hands stretching upward at the base of the occiput and finger cueing the muscles of the neck to release. Without breaking contact with the patient neck flex the finger at the metacarpophalangeal joint until finger are at right angle to palms. Begins a vertical release of the cranial base with the patients head supported on therapist at the tendinous insertion at the base of the occiput. Therapist finger tips will begin to move under and around the curve of the occiput while increased capital extension causes the patients chin to tuck. Therapist pushes her knuckle toward the patient feet while flexing proximal interphalangeal joint and placing fingertip under the curve of the occiput. Therapists maintain her finger flexion and use body weight to increase the stretch of the soft tissue at the cranial base pulling the patient's occiput back toward therapist. Finish the cranial base release with firm strong traction, placing the patient head in full capital extension (Stanborough, 2004; Yadav *et al.*, 2018) (Figure 3).



Figure 3: Showing Craniobasal Release of Suboccipital Region

Transcutaneous Supraorbital Nerve Stimulation

Self-adhesive electrodes were placed on the forehead and covering the Supratrochlear and Supraorbital nerve bilaterally (Riederer *et al.*, 2015; Miller *et al.*, 2016). The Transcutaneous Supraorbital nerve stimulation was given at frequency 60Hz, pulse width 250 μ s and intensity 16Ma for a period of 20 minutes. After 20 minutes of treatment session all knobs were turned to zero and all electrodes were removed (NICE, 2016; Tao *et al.*, 2018) (Figure 4).



Figure 4: Showing Supraorbital Nerve Stimulation Using TENS

All subjects were instructed to perform relaxed breathing exercises comprising of diaphragmatic breathing for a duration of 5 minutes in both the groups (Kisner and Colby, 2007).

RESULTS

Data was collected on the baseline pre-intervention and the last day of the 3rd week post-intervention. Mean and Standard Deviation of the outcomes were used for comparisons. SPSS version 22.0 was used for analysis. Data analysis included Descriptive characteristics of the subjects, Within-group comparisons, and Between-group comparisons. Kruskal Wallis test and Mann Whitney U test were applied for within and between-group comparisons of VAS and HIT-6. Data was analyzed at 95% CI and $P < 0.05$ was considered as significant.

In the study, 32 subjects with mean age participated in the study and they were divided into two groups which included 16 subjects in Group A and Group B. The mean age of subjected in group A and B was recorded as 34.18 ± 8.91 and 21.25 ± 1.91 respectively (refer to Table 1).

Table 2 shows Mean, Standard deviation, z and p value for Group A. When Pre and Post values for HIT-6 and VAS were compared, the p value was found to be significant (< 0.01).

Table 3 Shows Mean, Standard deviation, z and p value for Group B. When Pre and Post values for HIT-6 and VAS were compared, the p value was found to be significant (< 0.01).

Table 4 Shows comparison of Post values for HIT-6 and VAS between the groups using Mann Whitney U test. The result showed Non-significant differences for both the variables with $P > 0.05$. The Graph 1 shows the comparison of mean for HIT-6 Questionnaire and VAS within Group A. The Graph 2

Table 1: Within Group A and B the Number of Subjects and Age Wise Distribution of Subjects

Group	No. of Subjects	Mean Age \pm SD
Group A	16	34.18 \pm 8.91
Group B	16	21.25 \pm 1.91

Table 2: Comparison within Group A using Wilcoxon signed rank test

Variable		Mean \pm SD	Z value	p value
HIT-6	Pre reading	67.81 \pm 4.83	-3.520	< 0.01
	Post reading	53.9 \pm 4.85		
VAS	Pre reading	8.12 \pm 0.62	-3.575	< 0.01
	Post reading	3.62 \pm 0.8		

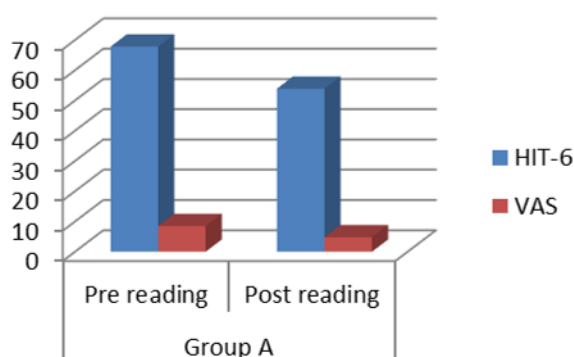
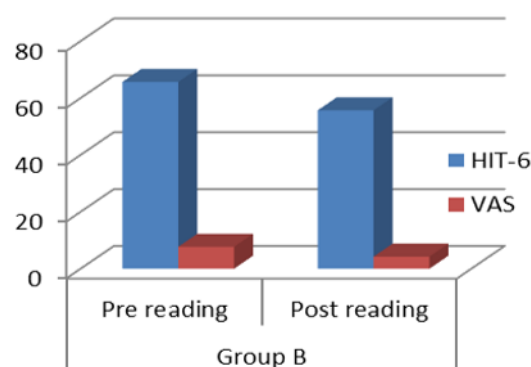
Table 3: Comparison within Group B using Wilcoxon Signed Ranks Test

Variable		Mean \pm SD	Z value	p value
HIT-6	Pre Reading	65.68 \pm 4.52	-3.522	<0.01
	Post Reading	55.7 \pm 4.37		
VAS	Pre Reading	7.8 \pm 0.77	-3.559	<0.01
	Post Reading	4.25 \pm 0.85		

Table 4: Comparison between Group A and Group B by using Mann Whitney U test

Variable	Z Value	P Value
VAS	-1.944	P = 0.052
HIT-6	-0.910	P = 0.363

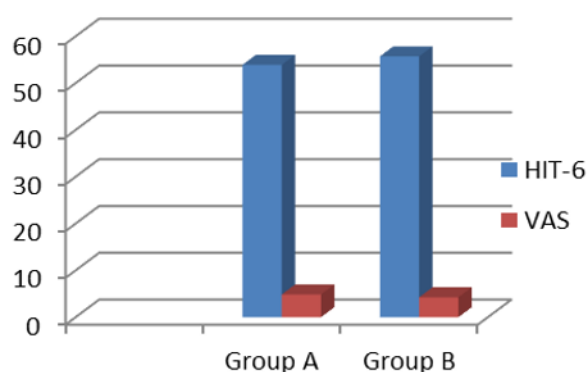
shows the comparison of mean for HIT-6 Questionnaire and VAS within Group B. The Graph 3 show the mean comparison between group A and B of HIT-6 Questionnaire and VAS at post-reading.

**Graph 1: Comparison of Means within Group-A****Graph 2: Comparison of Means within Group-B**

DISCUSSION

The present study aimed at finding out the effectiveness of cervical mobilization and Transcutaneous Supraorbital nerve stimulation in migraine patients without aura and compared between them. The

data was analyzed using Wilcoxon signed ranks test and Mann Whitney u test for statistical analysis. In the study, thirty two subjects having migraine without aura were selected and assigned randomly into two groups of sixteen subjects each of which Group A subjects received cervical mobilization which includes Maitland mobilization, Mulligan SNAGS and Myofascial release technique while Group B subjects received Transcutaneous Supraorbital nerve stimulation for twenty minutes. Disabil-



Graph 3: Comparison of Mean between the Groups

ity, frequency and intensity of pain were the parameter considered for the study and it was measured using Headache impact test -6 questionnaires (HIT-6) and Visual analogue scale (VAS) on the first day before the intervention and at third week after intervention.

The results of the study demonstrated a significant improvement in migraine headache disability, frequency (HIT-6), pain (VAS) when compared within the group for both the groups (< 0.01). However, between group analyses revealed a non-significant difference in migraine headache disability, frequency and pain, post intervention (> 0.05).

Mobilization group show significant improvement in HIT-6 Questionnaire following three weeks of intervention with cervical mobilization. Previous studies demonstrated effectiveness of manual techniques on pain in patients with the translatory dorsal glide mobilization technique (Silberstein, 2015; Schmid *et al.*, 2008).

Mobilization helps to restore normal mobility of the Vertebral segments and inhibits the nociceptors which were under excessive mechanical stresses in dysfunctional position. It was also found that improving mobility of the joint could activate type I and II receptors in the joints which inhibit pain. Mobilization inhibits the firing of nociceptors in the Trigemino-cervical complex on spinal level which is an important etiological factor for Migraine (Akbarak *et al.*, 2001; Biondi, 2005). Similar studies also found that mobilization of upper cervical spine causes stimulation of the greater occipital nerve that brings changes in the Trigemino-cervical complex (TCC) neurons, the concept that perception of cranial pain is due to a functional convergence between trigeminal and cervical fibers in the TCC (Wade and Franklin, 2015; Chaibi *et al.*, 2011). Studies on Mulligan techniques including C₁-C₂ SNAG found reduced headache symptoms. This is attributed to the neuro-modulatory effect of mobi-

lization and activation of descending pain-inhibitory systems which are mediated by areas such as the periaqueductal gray of the midbrain. It was found that the end range positioning in rotation with the C1-C2 SNAG may engage these inhibitory systems and reduce pain (de-las Peñas *et al.*, 2006; Sam-sam and Ahangari, 2016). Mobilization group also showed significant improvement in Visual Analogue Scale (VAS) following three weeks of intervention with cervical mobilization.

Transcutaneous Supraorbital nerve stimulation group showed significant improvements in Frequency and Pain severity in migraine without aura. This can be due to the effectiveness of TENS in blocking the afferent information activity of nociception by activating large diameter A - β fibers at level of trigeminal cervical complex. "It is also seen that the significant improvement of Transcutaneous Supraorbital nerve stimulation on migraineurs is due to convergence of somatic afferents from the trigeminal or the C2 territories with visceral trigeminovascular afferents on spinal trigeminal nucleus. Nerve stimulation may block the nociceptive activity at the segmental level via activation of large A-beta afferent fiber according to pain gate theory" (Russo *et al.*, 2015). Electrically stimulating the greater occipital nerve causes increased metabolic activity of the Trigemino cervical complex and release neuropeptides, such as substance P, from laminae I and II that diffuse to laminae III to V depending on the intensity of the stimulus. TCC is formed by the upper cervical dorsal horns and the trigeminal nucleus caudalis, which allows nociceptive input to be transmitted from the TCC to higher centers. Pain modulatory structures such as the PAG, dorsolateral Ponto mesencephalic tegmentum, and rostral ventromedial medulla control the TCC-mediated generation of antinociceptive mechanisms. Studies on eTNS demonstrated segmental "gate control" mechanisms as well as supra-segmental actions. A single session of eTNS in migraine patients during an attack relieved pain transiently and after several months of eTNS, there was a significant decrease in monthly attack frequency in compliant patients (Schoenen, 2017). Russo *et al.* (2015) in their study showed the results of a fluorodeoxyglucose (FDG)-PET study that analyzed brain metabolism in patients suffering from episodic migraine without aura. Immediately after one 20-min session of Transcutaneous Supraorbital nerve stimulation showed a significant reduced hypo-metabolism in orbitofrontal, rostral anterior cortices and middle temporal lobe (Schoenen, 2017).

Between the group comparison

Subjects were compared for scores of HIT-6 questionnaire and VAS between the groups A and B, and the analysis showed non-significant differences. The findings of the study suggest that though both regimes produced significant effects on reducing disability, frequency and pain separately, but when compared, both of them showed non-significant difference in their effects. Both cervical mobilization and Transcutaneous Supraorbital nerve stimulation activate descending pain inhibiting system mediated by areas such as the periaqueductal grey of the midbrain (Wade and Franklin, 2015). But MFR given in group A combined with cervical mobilization, reduce tension including abnormal stress on the head and neck by compressing and stretching the fascia. The treatment by MFR is relaxing the Myofascial structures and has a positive effect on emotional state of subjects, adding to a psychological component along with mobilization (Chaibi et al., 2011). Non-significant results may also be attributed to the psychological benefits of MFR treatment along with cervical mobilization in subjects with migraine without aura. Hence, it is imperative to say that both the techniques have significant results in reducing disability, frequency and pain on migraine without aura.

Hence it can be concluded from the findings that both strategies are significant in treating migraine separately but neither of them is superior over other when compared.

Limitation of the Study

1. Duration of protocol was short (only for 3 weeks).
2. Inability to create a special environment for subject to be treated and Factor like behavior, interest and attitude of the subject were not taken into consideration.
3. Only female subjects were included in the study.

Future Scope of the Study

1. Study can be done on a heterogeneous group.
2. Comparing the effect of cervical mobilization and Transcutaneous Supraorbital nerve stimulation with other type of treatment regimen in patients with migraine without aura.
3. Further studies on cervical spine pathogenesis include Cervicogenic headache, Tension type headache, and Cluster headache.

Clinical Significance

Cervical mobilization and Transcutaneous Supraorbital nerve stimulation can be used to reduce disability, frequency and pain in migraine without aura. It can be used to reduce stress, anxiety in migraine patients.

CONCLUSION

Cervical mobilization and Transcutaneous Supraorbital nerve stimulation can be a valuable option to treat migraine without aura. These protocols can be utilized as a direct method of treatment or an adjunct to other non-pharmacological methods to manage migraine without aura.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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